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Discussion of Possible Content of an IAEA Handbook/Computer File for Data for Medical Radioisotope Production

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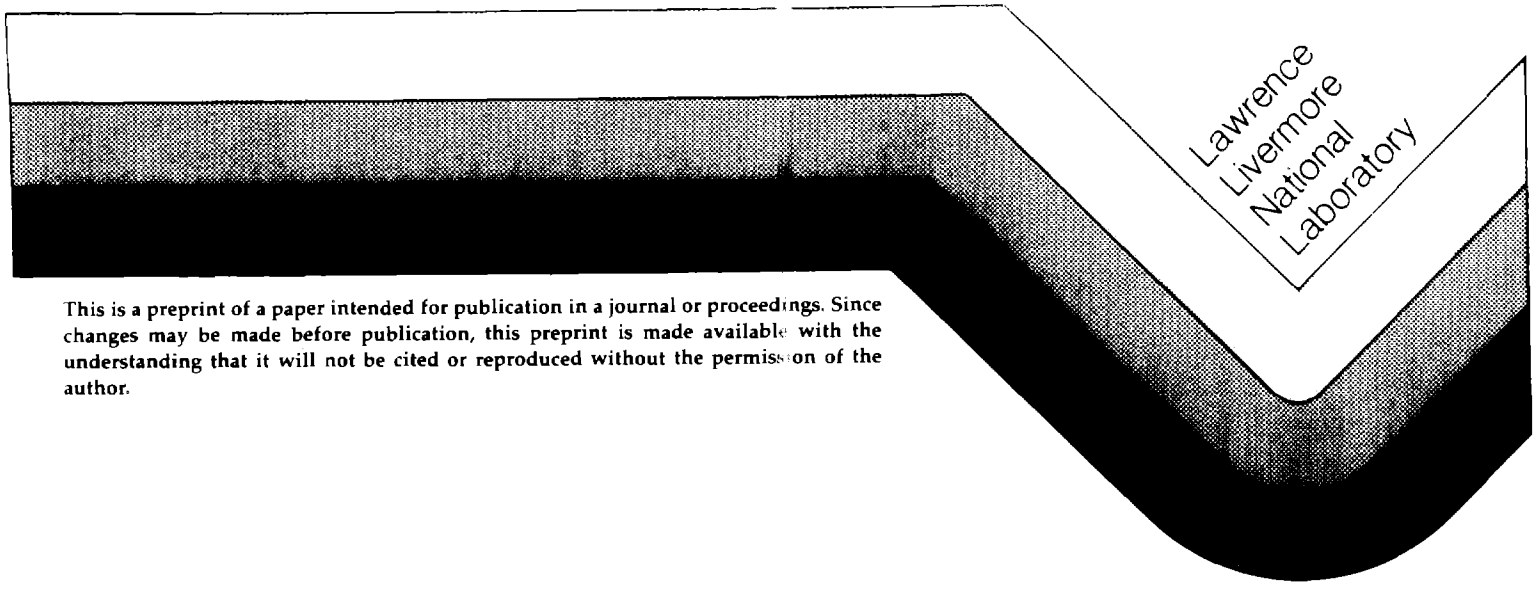

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Several possible approaches will be put forward in order to stimulate discussion and seek consensus on the relative emphasis and format of a proposed IAEA handbook and computer file for "Data for Medical Radioisotope Production." An outline for possible chapters for non-nuclear physicists will be presented describing low, medium and high energy reactions induced by light projectiles (e.g., n,p,α), by photons, and by heavy ions. Qualitative features would be described, typical experimental examples would be presented to illustrate each type of reaction, and examples would be presented of how well various computer codes would permit the calculation/prediction of the experimental results. We next solicit discussion of the desirability of the above, and of the format and means of compilation of a computer data file for isotope production. This should include format of experimental data, and also, whether a calculated file should be presented for production of particular isotopes from a "most wanted" list.

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Discussion Outline for a Handbook/Computer File "Data for Medical Radioisotope Production"

M. Blann

for the I.A.E.A. Coordinated Research Project on Radioisotope Production for Medical Applications, Tokyo, Japan, 20-24 April 1987

I. Introductory comments on goals of document, and organization/comment of following chapters.

II. Qualitative discussion of processes determining nuclear reaction yields, with partition of regimes into: (a) light particle induced - low to medium energy reactions ($E_{incident}$ ~ 10-50 MeV/AMU; n,p,d,t,^{3}He,α), (b) high energies >50 MeV/AMU; (c) heavy ion induced reactions; (d) photonuclear reactions. This discussion should point out the questions and compromises involved in selecting a reaction for producing a particular isotope. It should concentrate on the main and important mechanisms, not bog down on the many minor processes. This overview will be somewhat repeated in following sections where the idealized examples will be replaced with relevant experimental examples.

III. Compound and Precompound Processes for Light Ion Induced Reactions at Medium Excitation: Theory and Applications.

The excellent article by Novotny and Uhl fulfills the needs of this section brilliantly, and provides the theoretical background necessary for the following sections.

IV. Compound Reactions Involving Heavy Ions (e.g., Li, c, N)

Presentation of experimental results; comparison of excitation functions with those for light ion induced reactions at like excitations. Illustrates much broader range of isotopes which may be produced with the higher yields characteristic of the compound nucleus mechanism. The latter is extended to higher excitations with heavy ions. Much more proton rich products may be produced via judicious target/projectile combinations. A set of illustrations using chart of the nuclides marked to show accessible regions of isotopes should be included. The less favorable $d\varepsilon/dx$ of heavy ions vs. lighter ions needs discussion. It should be stressed that this possibility has yet to be seriously exploited for medical isotope production, but is relatively well understood and "predictive."

V. High Energy Spallation Reactions

Present some "typical" experimental results, discuss flat energy dependence, low beam $d\varepsilon/dx$, very large "impurity" admixture, lower peak cross sections than for lower energy reactions. Compare typical beam currents of high energy vs. medium energy accelerators.

VI. $(\gamma,ypxn)$ - Photonuclear Reactions

Present some experimental excitation functions. Discuss usual broad spectrum of gamma's, high energy like excitation functions. Estimate possible yields as far as possible.

VII. (n,xn) Reactions at 14 MeV

VIII. Computational Tools for Selecting Optimum or Satisfactory Reaction for Isotope Production

A. Discussion of range and types of codes available. Which jobs may be done by which codes?

B. Comparisons of code results vs. data from III VII above.

C. Discussion of input requirements and computer requirements to perform calculations in question.

D. Discussion of regimes where such model codes should be at their best, and worst.

IX. Summary table of requested radioisotopes, suggested reactions for their production. Indication of reactions for which experimental data have been located and tabulated. Reference to computer data file I to find numerical experimental data. Make numerical data file II (?) with calculated excitation functions where no experimental data (or sparse) is available.

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